tence several years under exceedingly dense traffic and have given satisfaction."

Charles A. French, City Engineer of Laconia, New Hampshire, says in the Engineering Record of February 7, 1914: "This city has built since 1908 about 60,000 square yards of bituminous macadam pavement, the greater portion of which has been constructed by the penetration method and the remainder by the mixing method. All the work was done by day labor under the same supervision and by practically the same men and equipment using the same materials. We have found that penetration method to be much more satisfactory in every way and to be about 33% cheaper."

The New York Highway Department has built about 1,300 miles of bituminous macadam by the penetration method during 1909-10-11. These roads are reported to be in good condition now with very few failures. They have been giving excellent results with all indications that they will continue to give satisfaction for some time to come. The failures have been less than 1% of the total mileage built.

Where failures have occurred they can generally be traced to some defects in the original construction, and a study of the causes responsible for failure will now be made with the object of finding, by the light of past experience, the essentials of a construction method which will eliminate these causes. The main reasons for such failures as given by Spencer in "Transactions of the American Society of Civil Engineers" for 1914 are:

1. Improper foundation.
2. Improper sizes of mineral aggregate.
3. Top course becoming sealed before bitumen is applied.
4. Bituminous material of wrong consistency.
5. Uneven application of materials.

The surface indications of these various ways of failing are shown by: (a) depressions in the surface, due to settlement of foundation; (b) surplus of bituminous material on the surface, due to partial sealing of the top course before bitumen is applied; (c) raveling, due to bituminous material not adhering to stone; (d) wavy condition, showing either an unequal